HUMIDITY MEASUREMENT ANALYSIS FOR FLOW SIMULATIONS

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CERATIZIT GROUP

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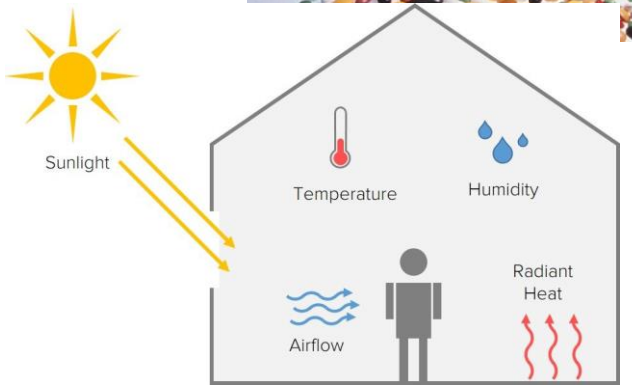
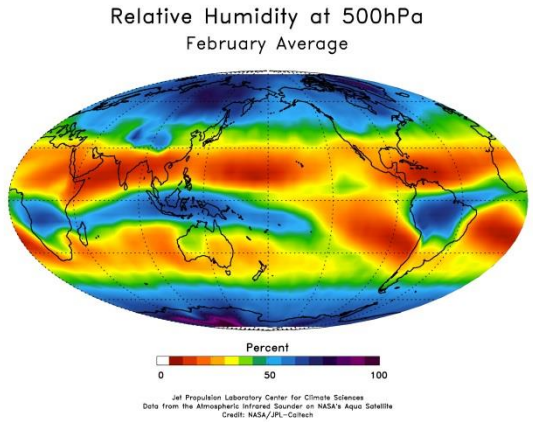
3 \ WHY HUMIDITY MEASUREMENTS



4 \ HUMIDITY



- **Relative humidity** (%)**:**

Relative humidity is at all temperatures and pressures defined as the ratio of the water vapour pressure to the saturation water vapour pressure (over water) at the gas temperature:

RH = Pw/Pws · 100%

- **Absolute Humidity** (g/m3) **:**

Absolute humidity is defined as the mass of water vapour in a certain volume.

- **Mixing ratio** (g/kg)

The mixing ratio (mass of water vapour/mass of dry gas)

- **Dewpoint** (°C, °F)

DEWPOINT

Wikipedia: The dew point is **the temperature to which air must be cooled to become saturated with water vapor**. When further cooled, the airborne water vapor will condense to form liquid water (dew). When air cools to its dew point through contact with a surface that is colder than the air, water will condense on the surface.[1][2] When the temperature is below the freezing point of water, the dew point is called the frost point, as frost is formed rather than dew.[3] The measurement of the dew point is related to humidity. A higher dew point means there will be more moisture in the air.[2]

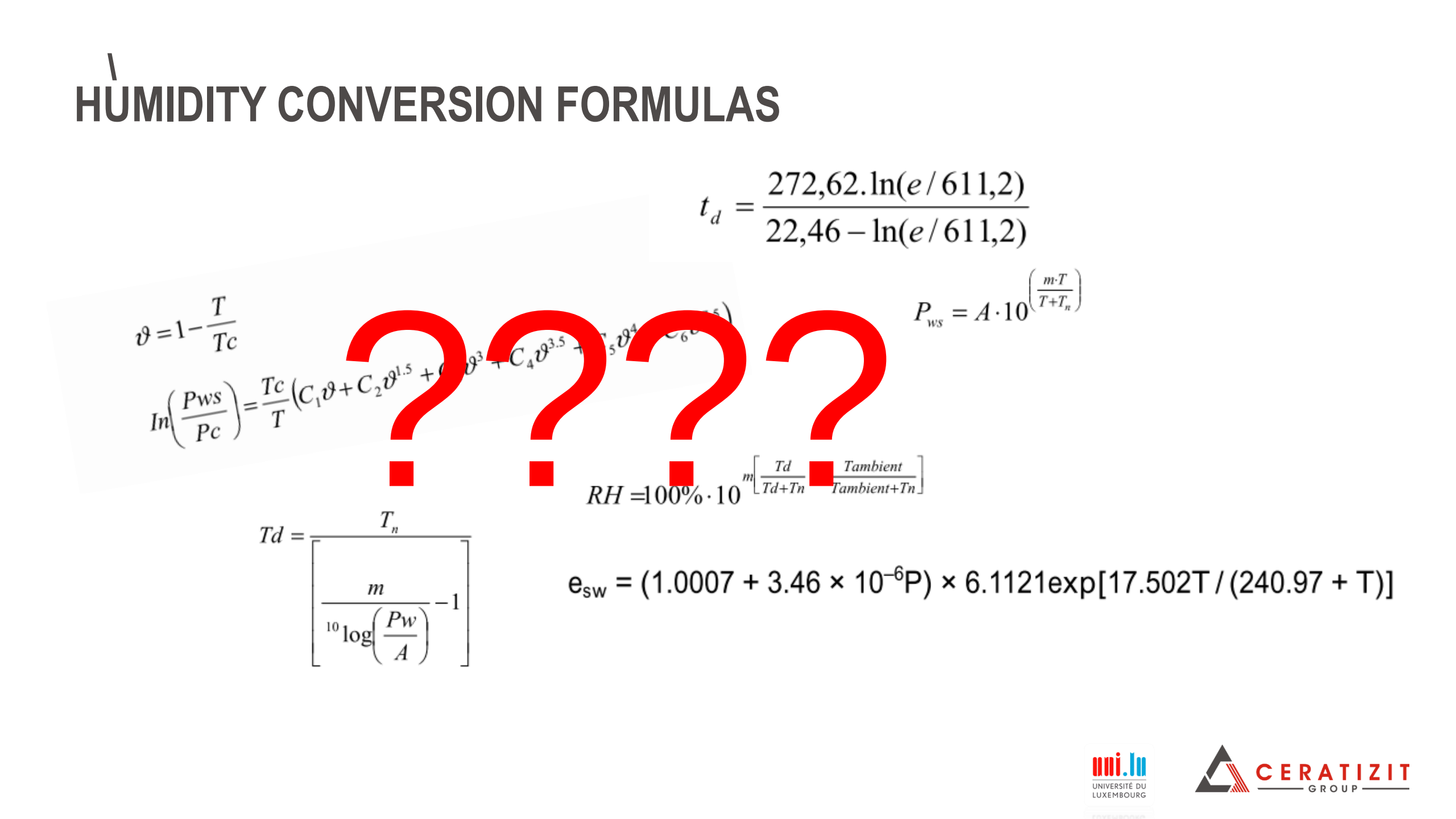
HUMIDITY CONVERSION FORMULAS

$$t_d = \frac{272{,}62.\ln(e/611{,}2)}{22{,}46 - \ln(e/611{,}2)}$$

$$\vartheta = 1 - \frac{T}{Tc}$$

$$P_{ws} = A \cdot 10^{\left(\frac{m \cdot T}{T+T_n}\right)}$$

$$In\left(\frac{Pws}{Pc}\right) = \frac{Tc}{T}\left(C_1\vartheta + C_2\vartheta^{1.5} + C_3\vartheta^{3} + C_4\vartheta^{3.5} + C_5\vartheta^{4} + C_6\vartheta^{7.5}\right)$$



$$RH = 100\% \cdot 10^{m\left[\frac{Td}{Td+Tn} - \frac{Tambient}{Tambient+Tn}\right]}$$

$$Td = \frac{T_n}{\left[\frac{m}{{}^{10}\log\left(\frac{Pw}{A}\right)} - 1\right]}$$

$$e_{sw} = (1.0007 + 3.46 \times 10^{-6}P) \times 6.1121\exp[17.502T/(240.97 + T)]$$

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- Introduction
  - Why humidity measurements
  - Humidity

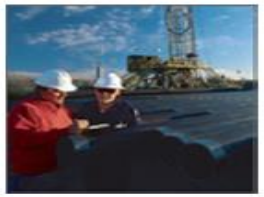
- **Humidity Measurements for Tungsten Powder Production**
  - **Hard-Metallurgy at Ceratizit**
  - **Laboratory furnace**
  - **Humidity measurements**

- XDEM predictions

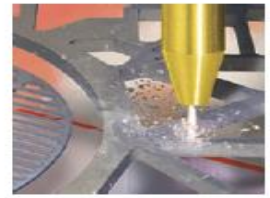
\ HUMIDITY MEASUREMENTS FOR TUNGSTEN POWDER PRODUCTION

CERATIZIT - Industrial segments

- Oil industry
- Paper industry
- Power generating industry
- Pump industry
- Railway industry
- Recycling technology
- Roller bearing industry
- Screw and nail industry



- Steel industry
- Stone working
- Textile industry
- Watch & jewellery industry
- Water jet technology
- Wire industry
- Wood industry



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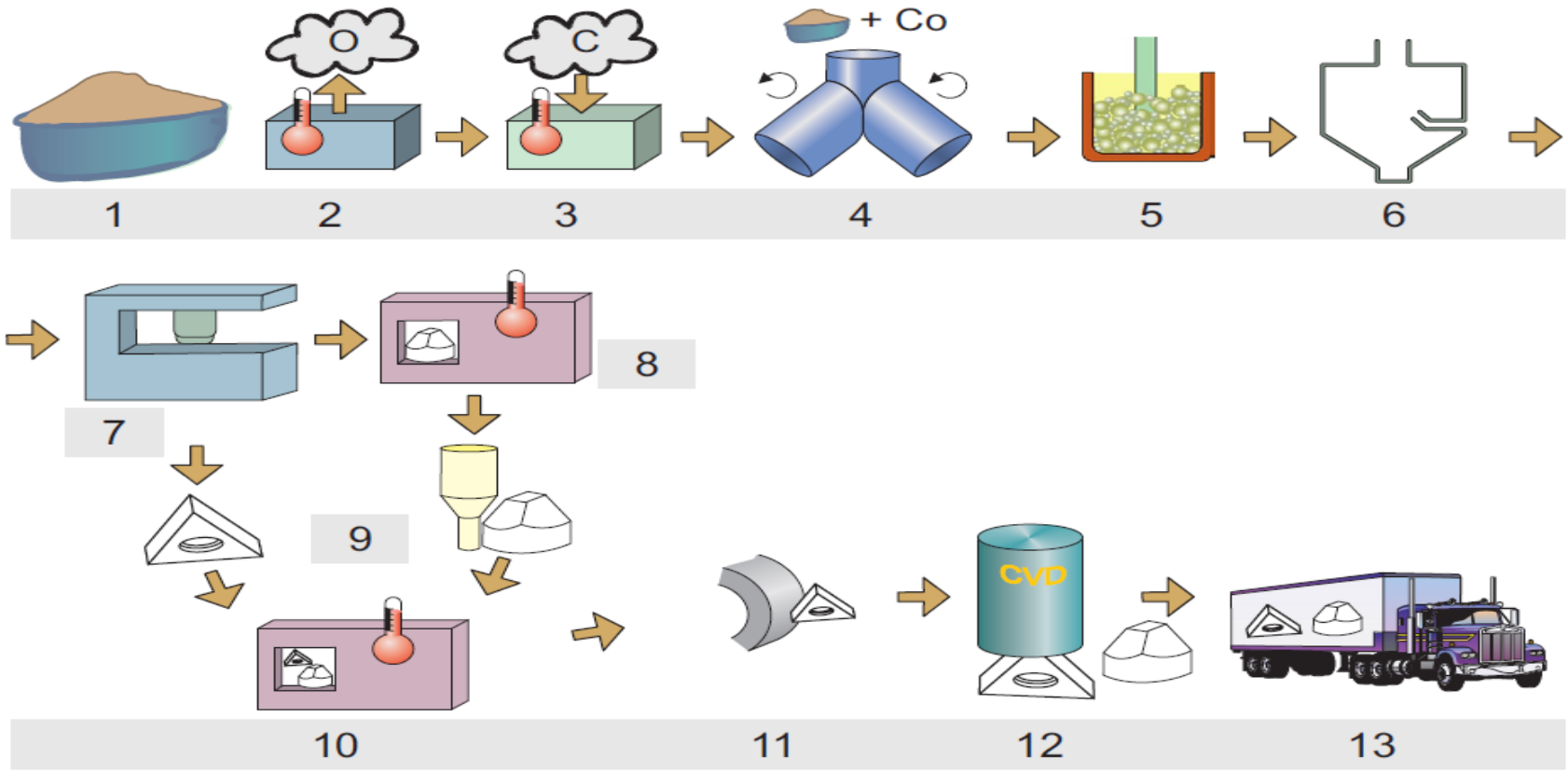
Carbide production process



1 W.Ti.Ta oxides
2 Reduction
3 Carburising
4 Mixing
5 Milling
6 Granulation
7 Pressing
8 Presintering
9 Forming
10 Sintering
11 Grinding
12 Coating
13 Dispatching

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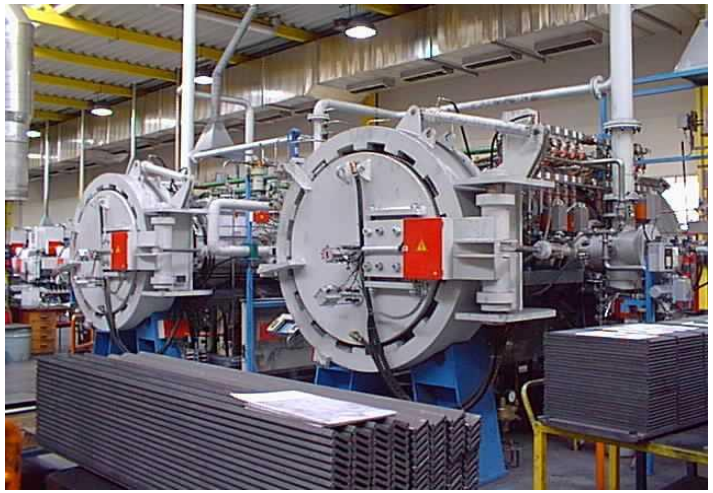
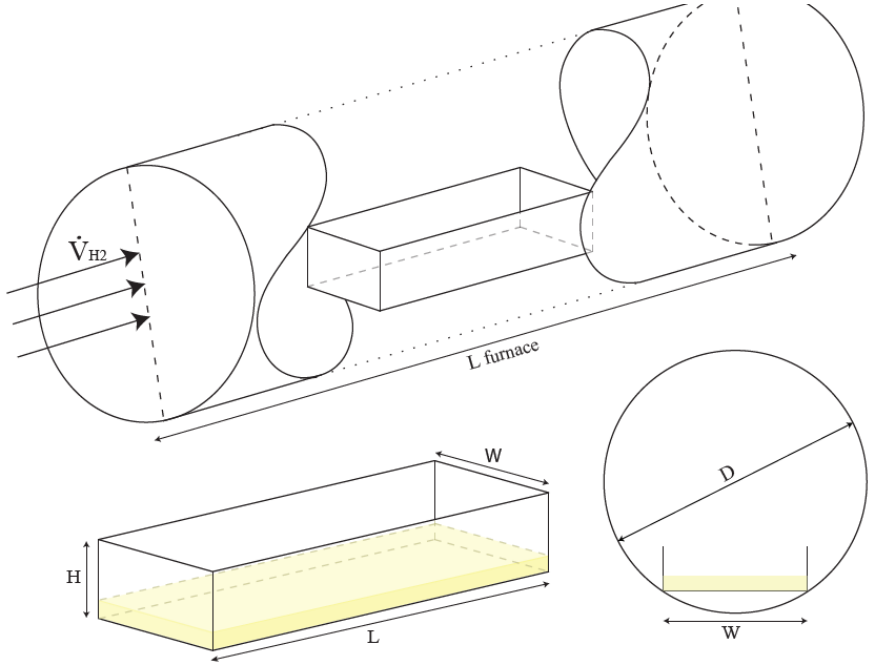


Sinter-HIP furnaces

Vacuum sinter furnaces



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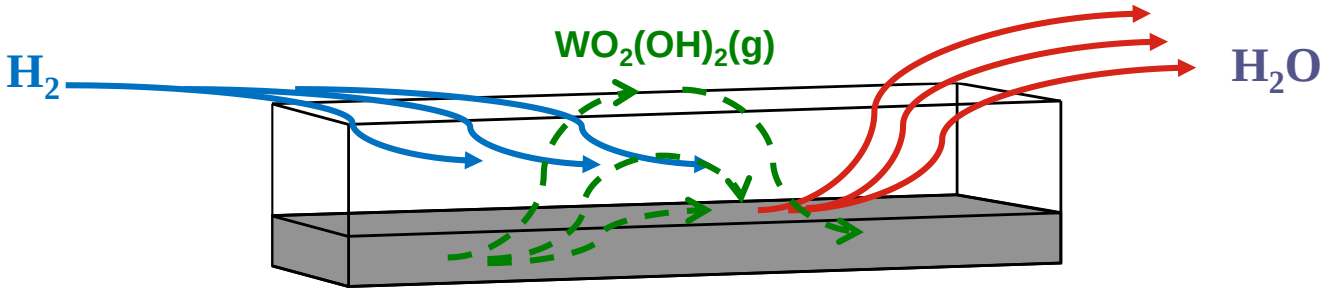
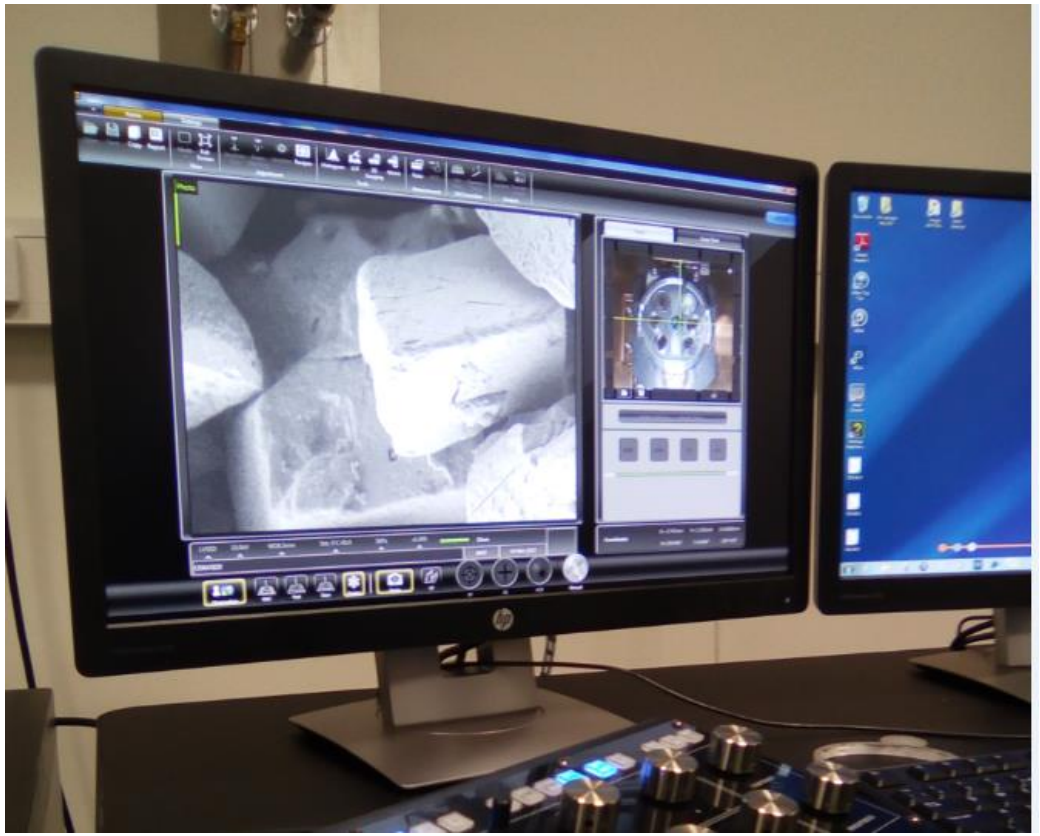
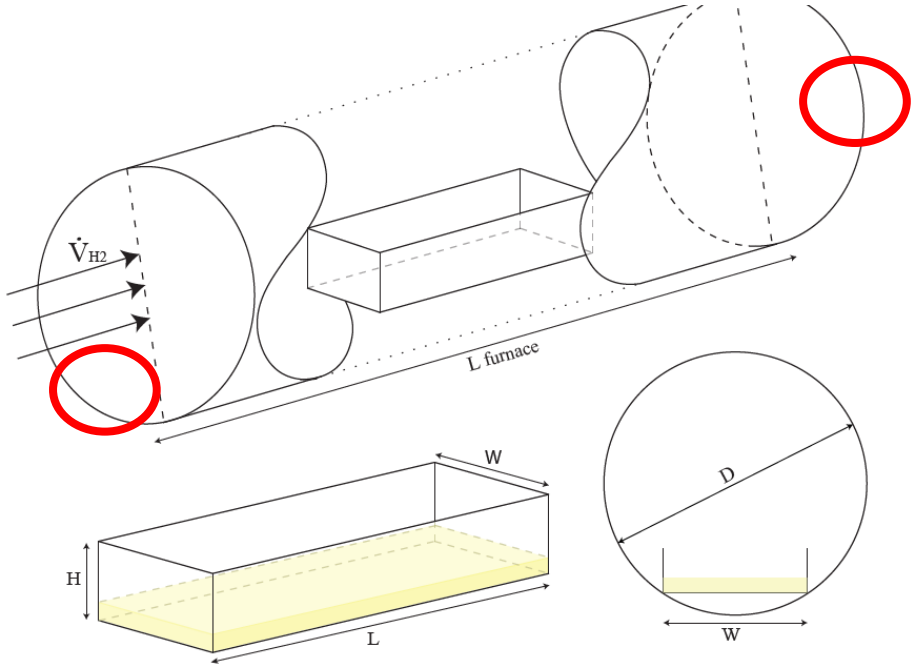


Container with powder



12 \ HUMIDITY MEASUREMENTS



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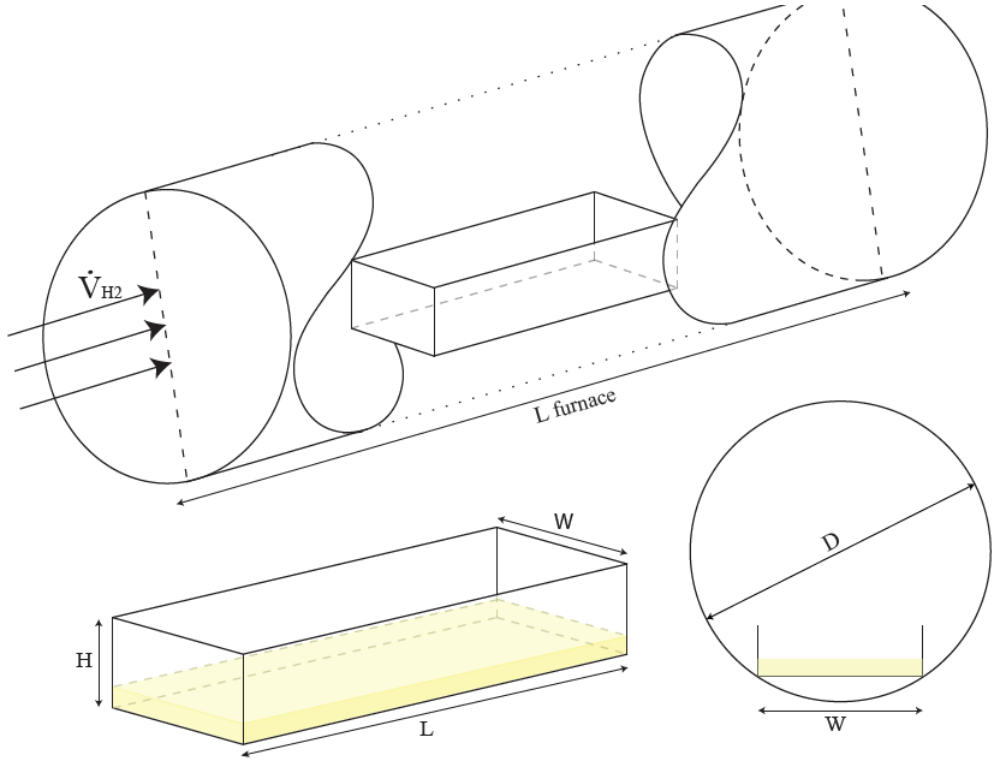

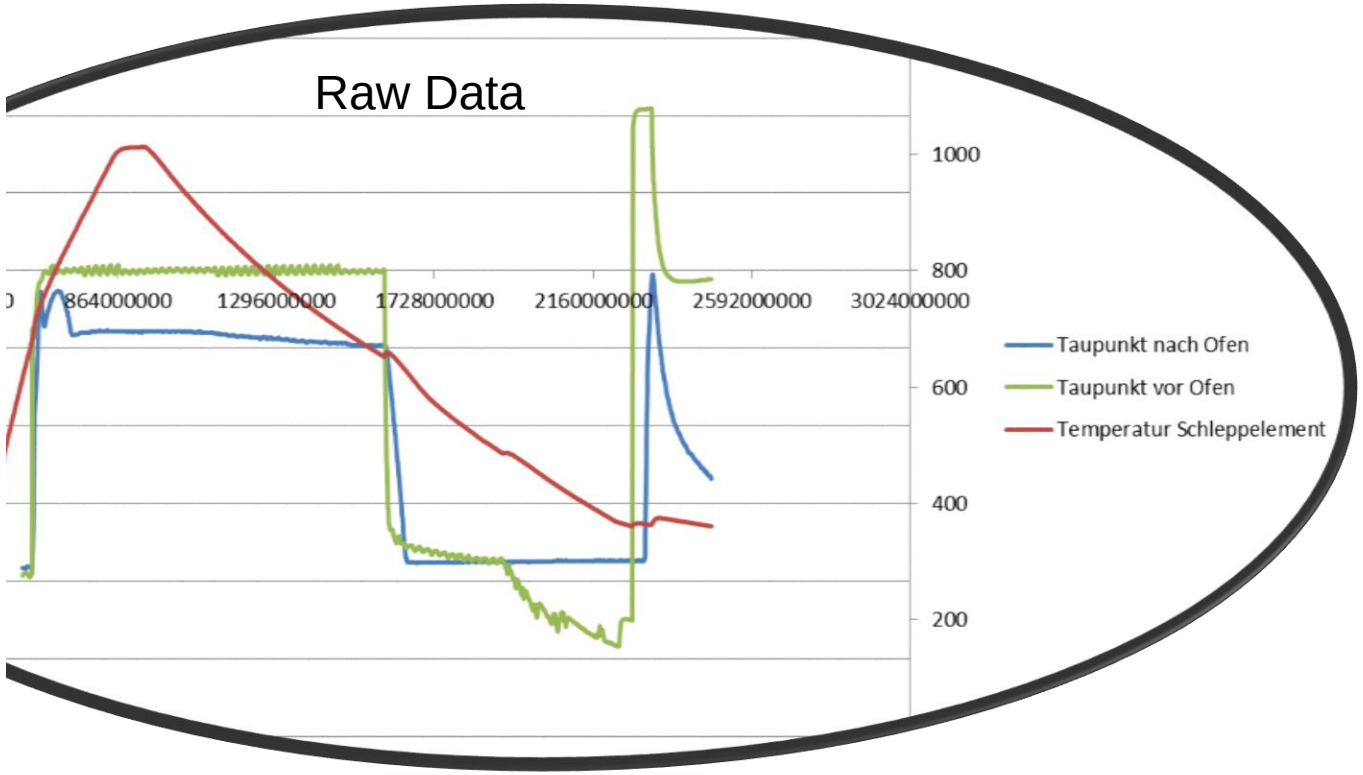

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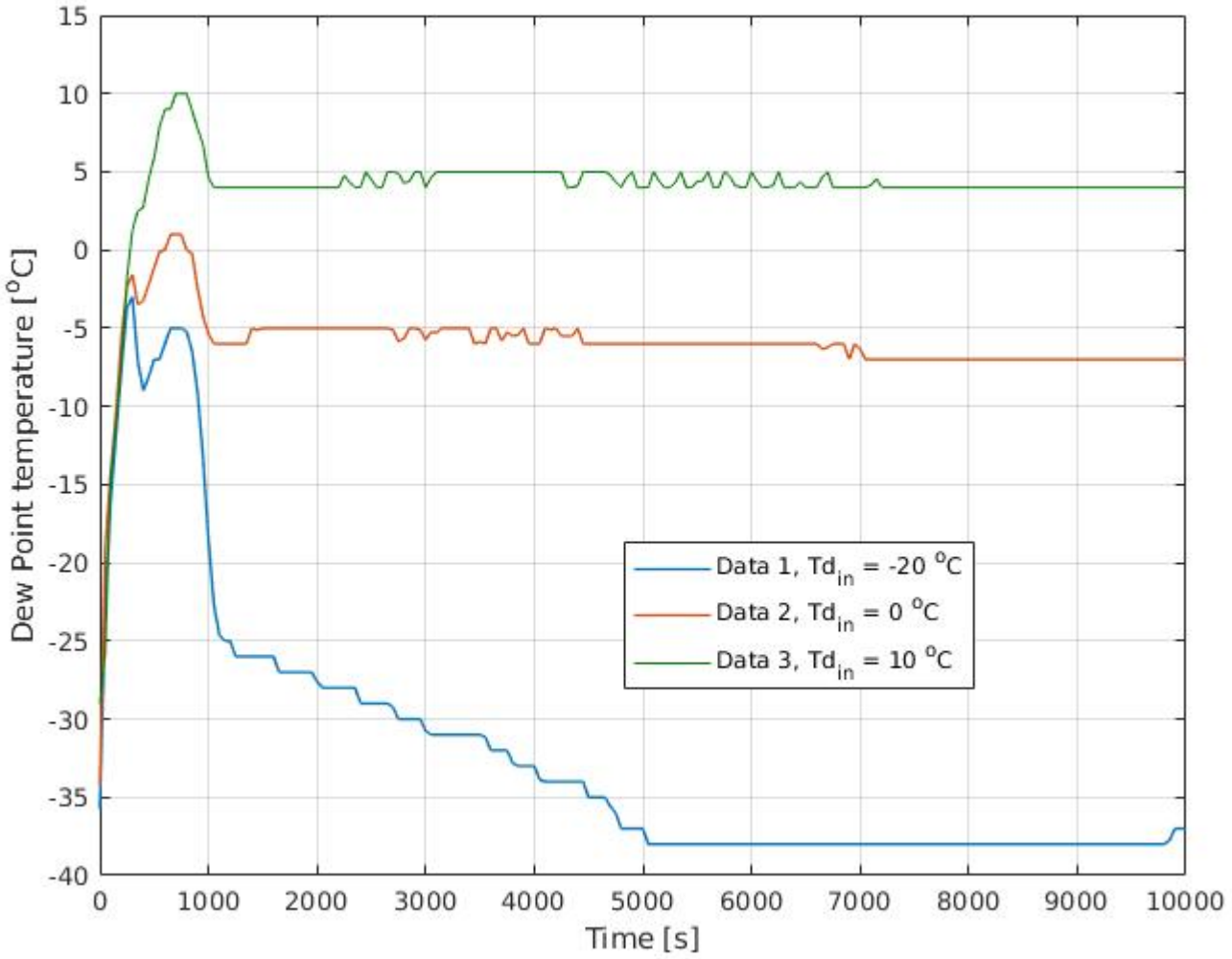
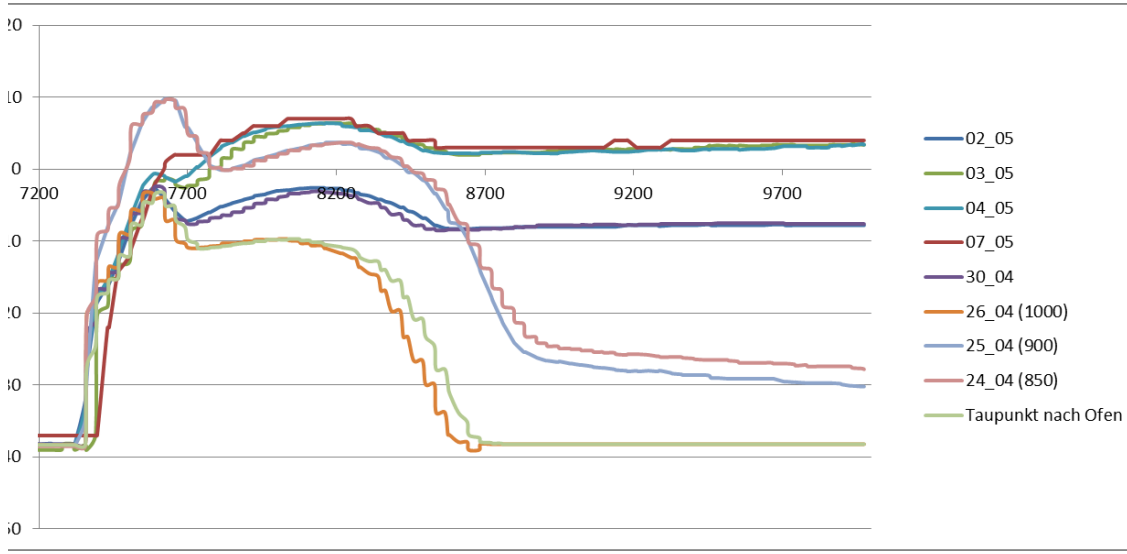


Reproducibility !



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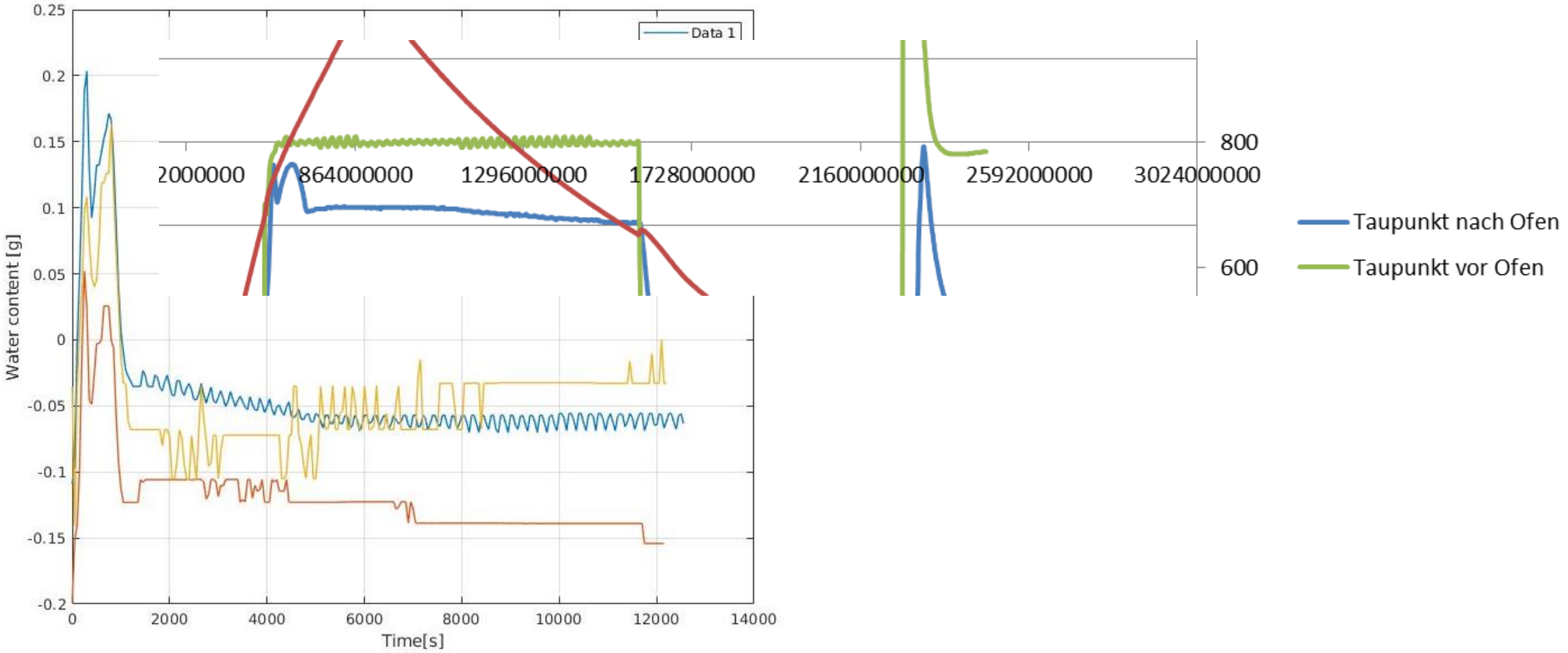
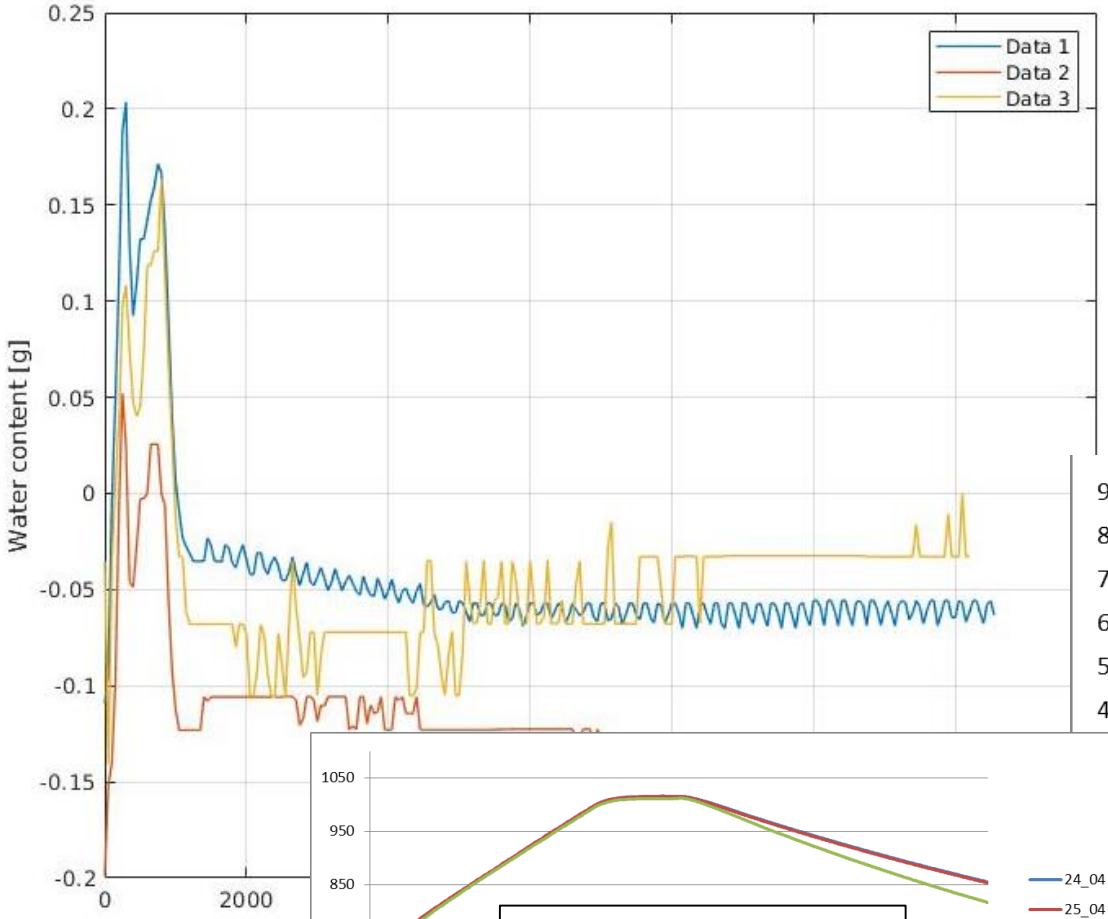
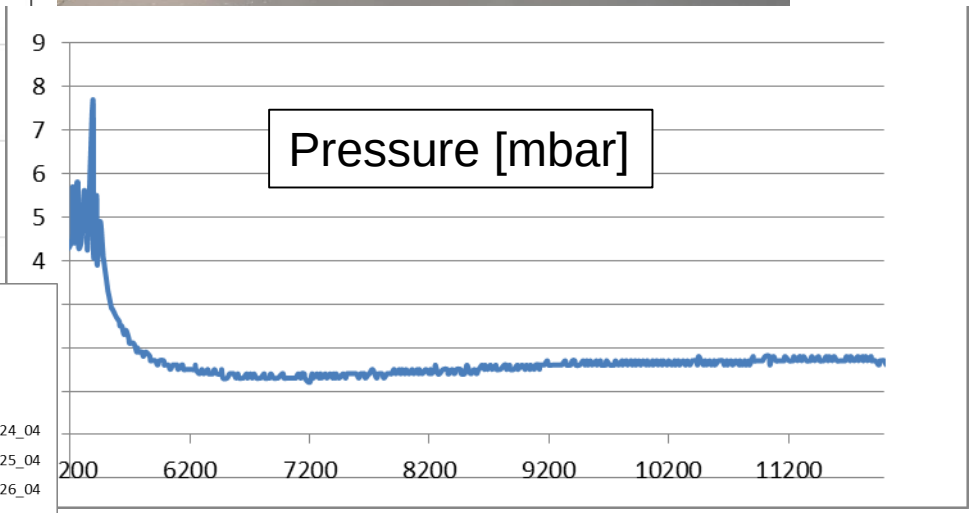


\ HUMIDITY MEASUREMENTS FOR TUNGSTE





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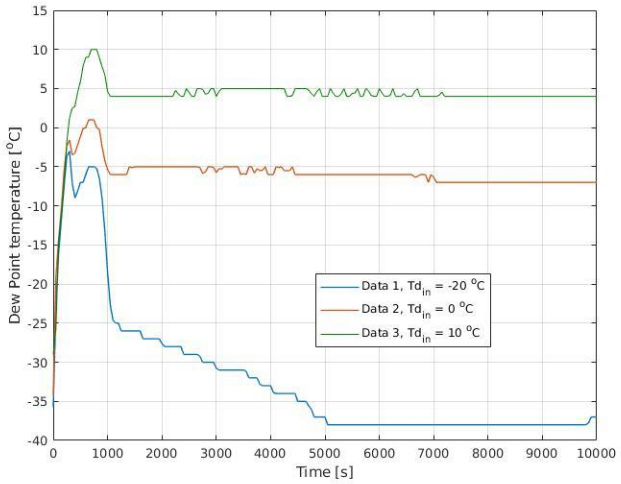

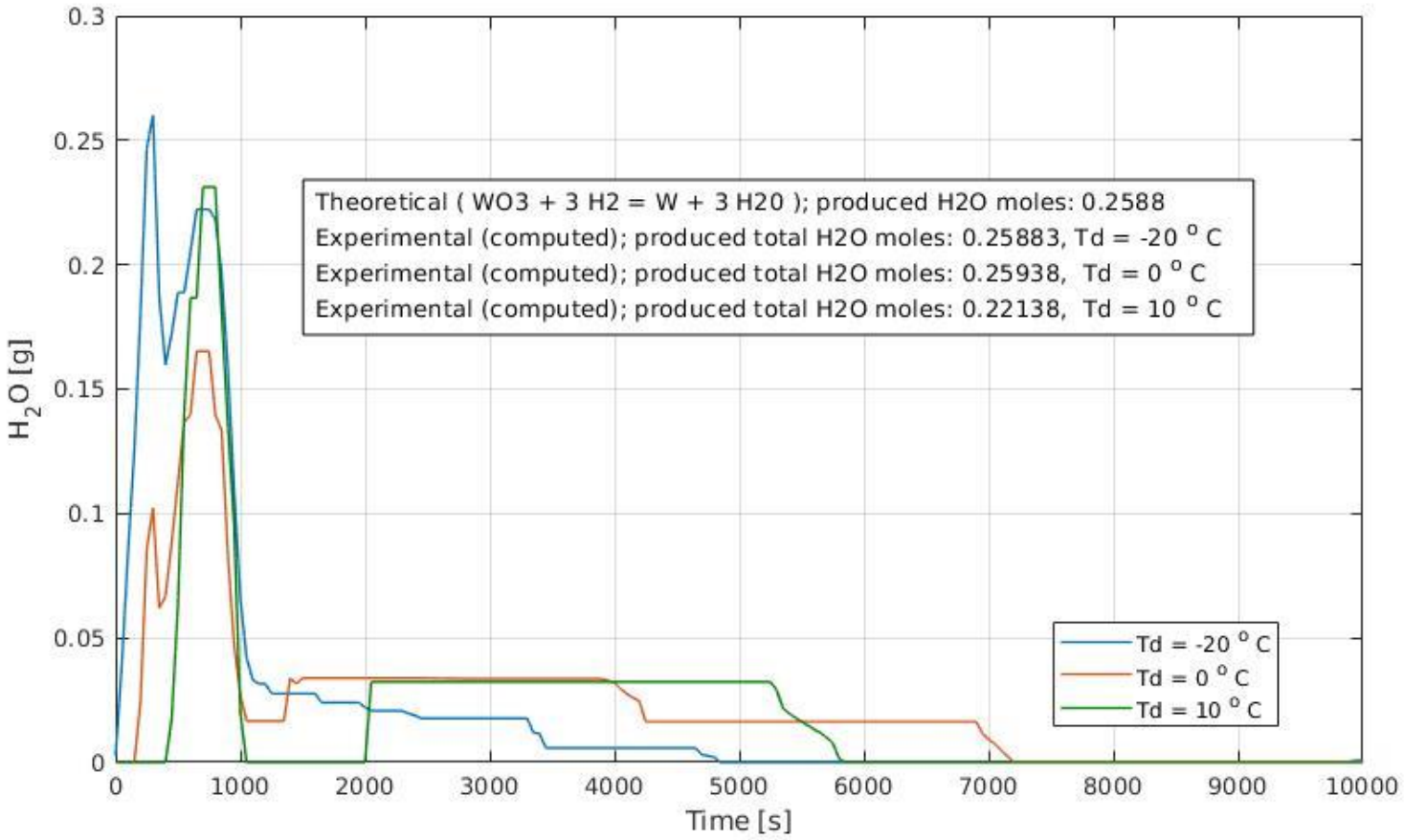

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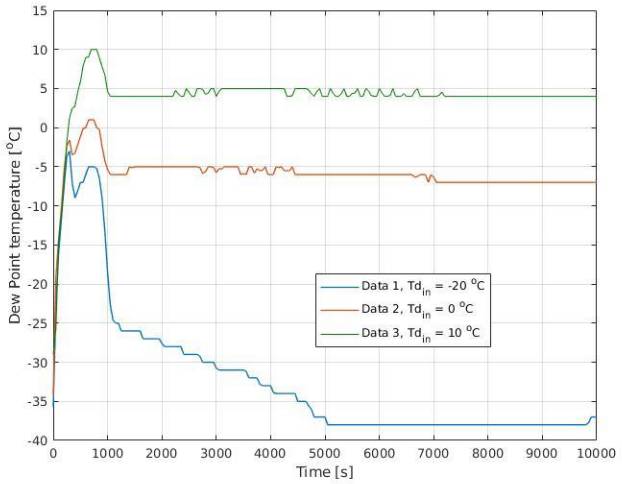

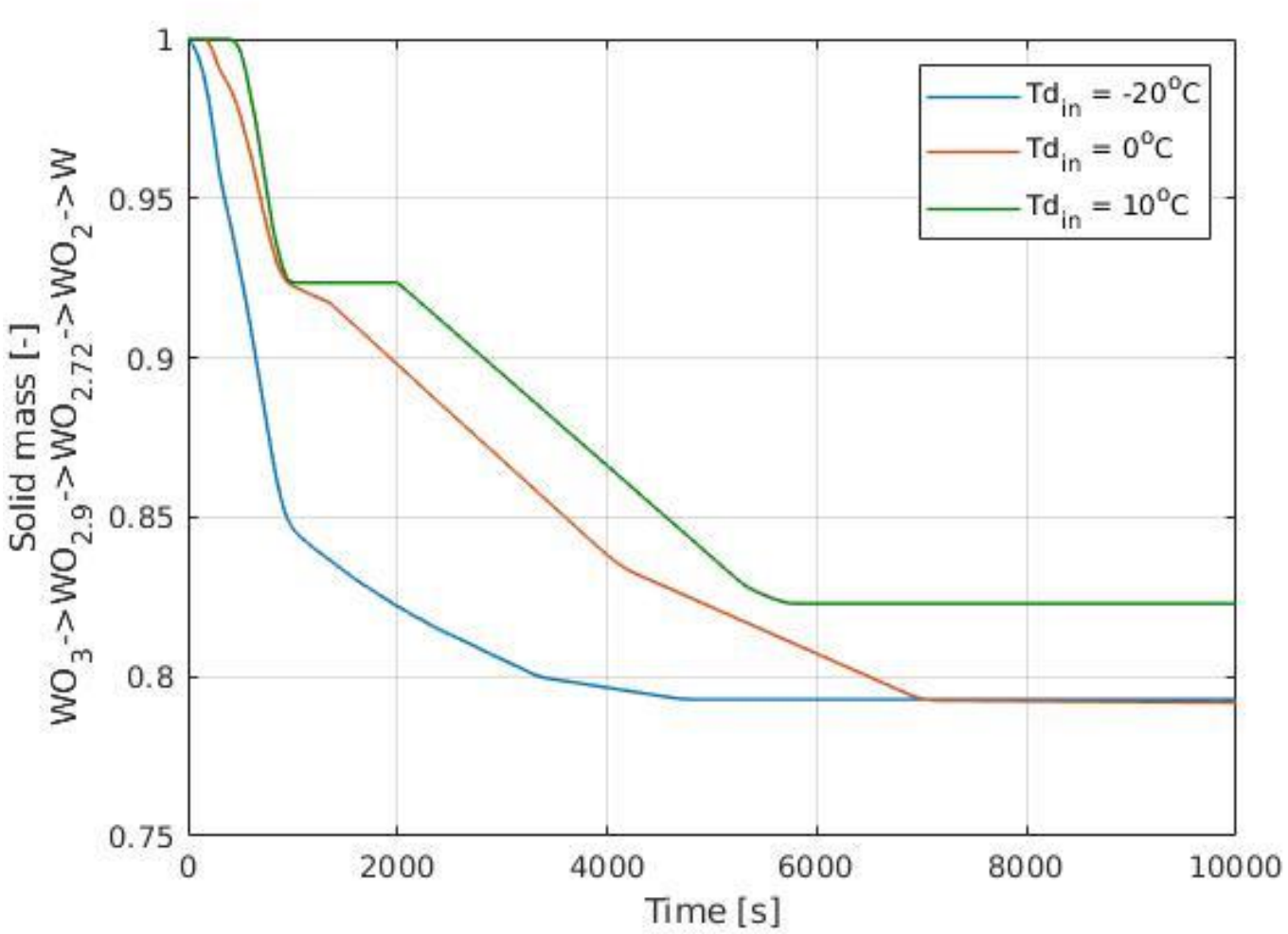

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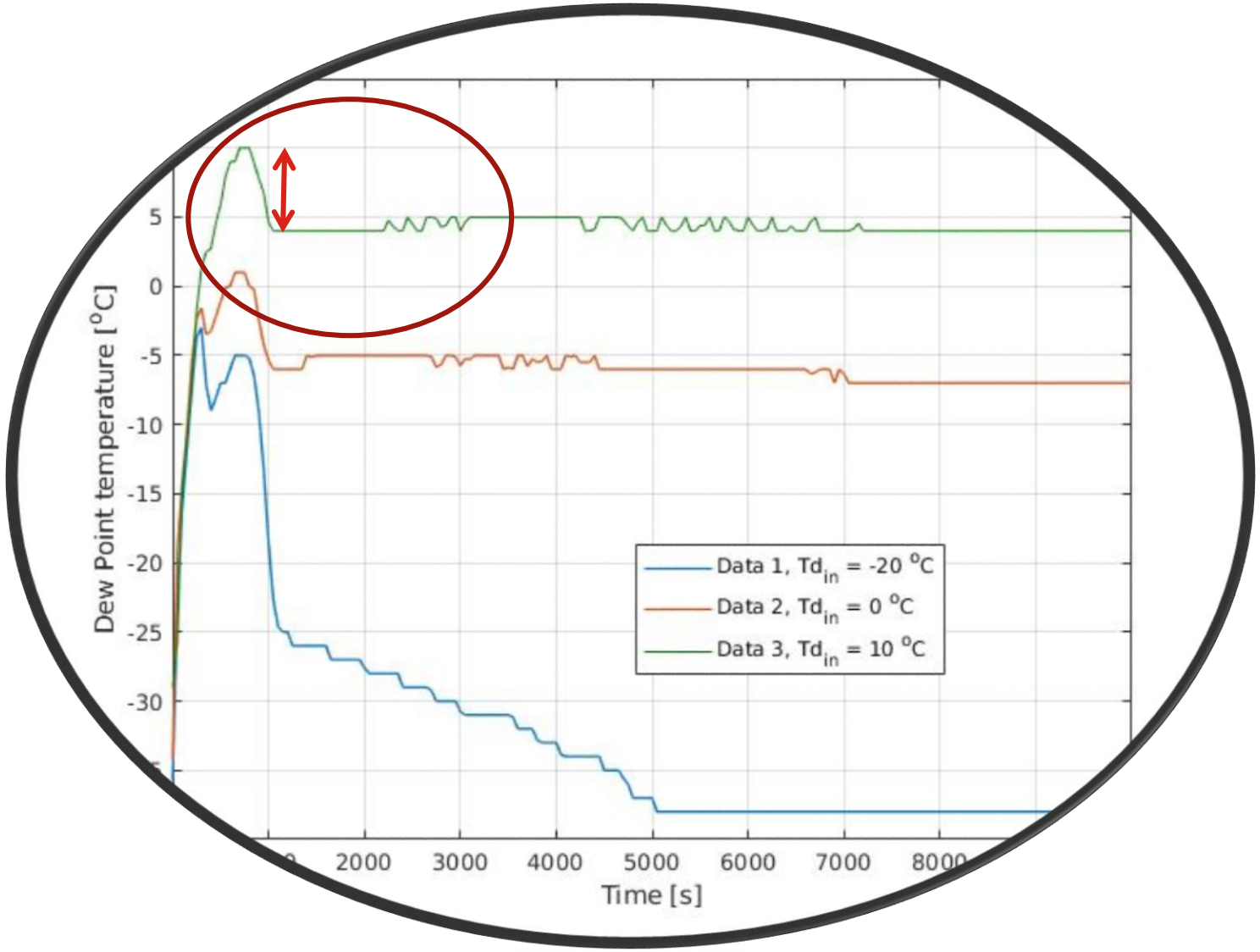

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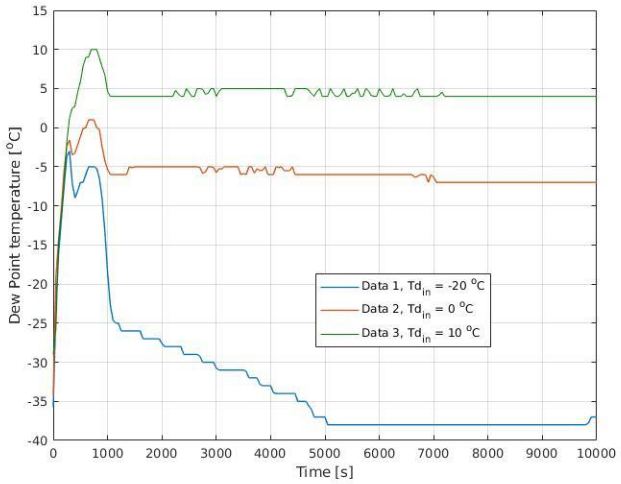
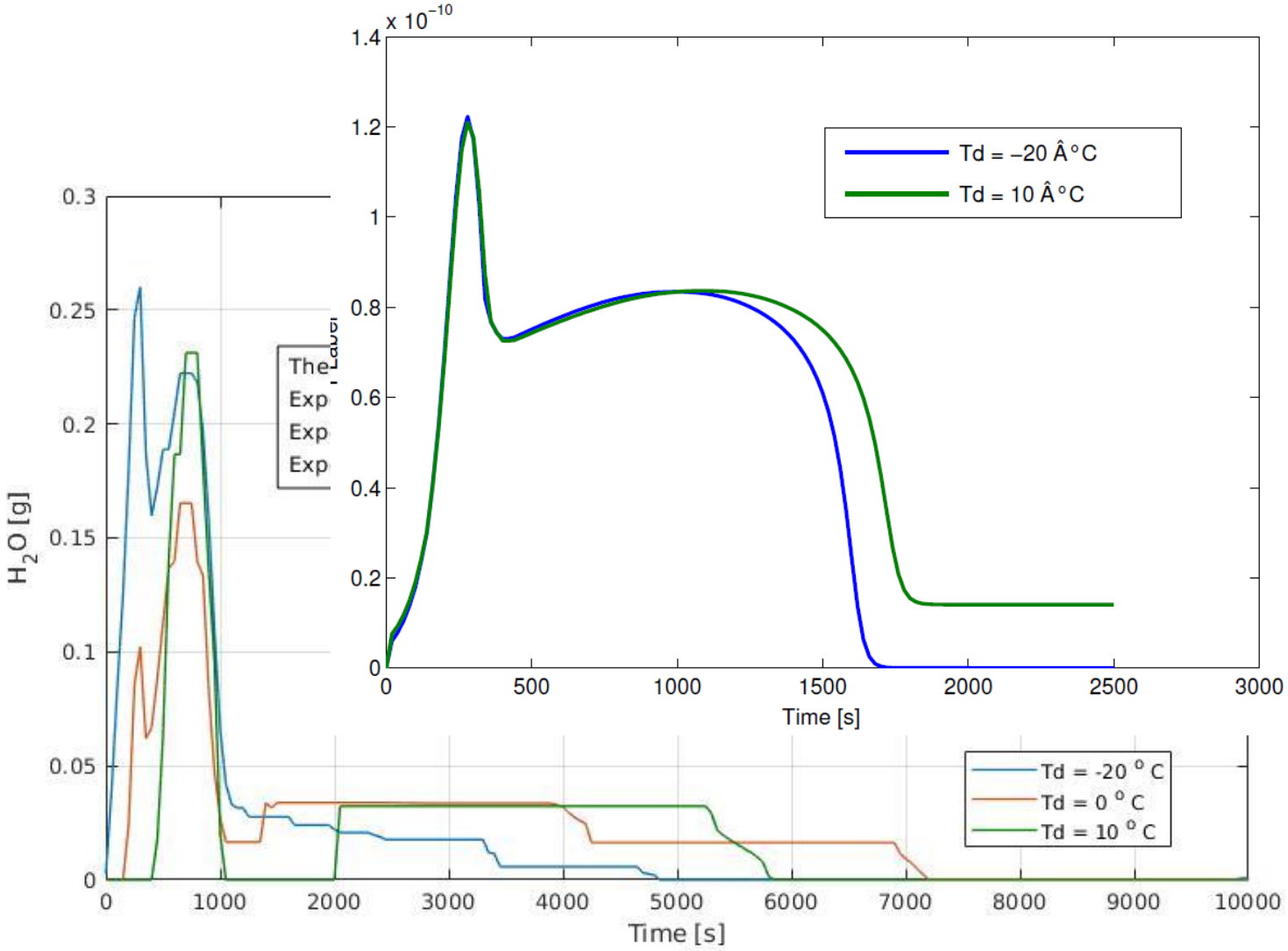
\ XDEM PREDICTIONS??





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